Real-Time Plant Monitoring

Installation Manual

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Warnings

** Warning **

Before beginning the installation, make sure all the following precautions are taken:

- **120 VAC power supply to the Plant Controller cabinet is turned off.**

- **The DeviceNet cable system is inactive:**
  - **All devices attached to the DeviceNet cabling are turned off.**
  - **All auxiliary power supplies attached to the DeviceNet are turned off.**

- **Manufacturer's instructions for stripping, crimping, and/or tightening are followed (as outlined in the following sections of this document).**

- **All equipment must be installed in compliance with any applicable National and / or Local regulations or codes.**

Overview

The Real-Time Plant Monitoring System will collect data from a network of Photo-Eye sensors and/or DeviceNet Adapters located on equipment throughout the plant floor. Hardware and software components located in the Plant Controller will collect signals from those sensor inputs.

A Programmable Logic Controller (PLC) located in the Plant Controller will increment and reset the piece counts from each Photo-Eye sensor and determine the operating mode and rate of each piece of equipment.

Imaginera will obtain data from the industrial computer located in the Plant Controller via the plant's Ethernet network.

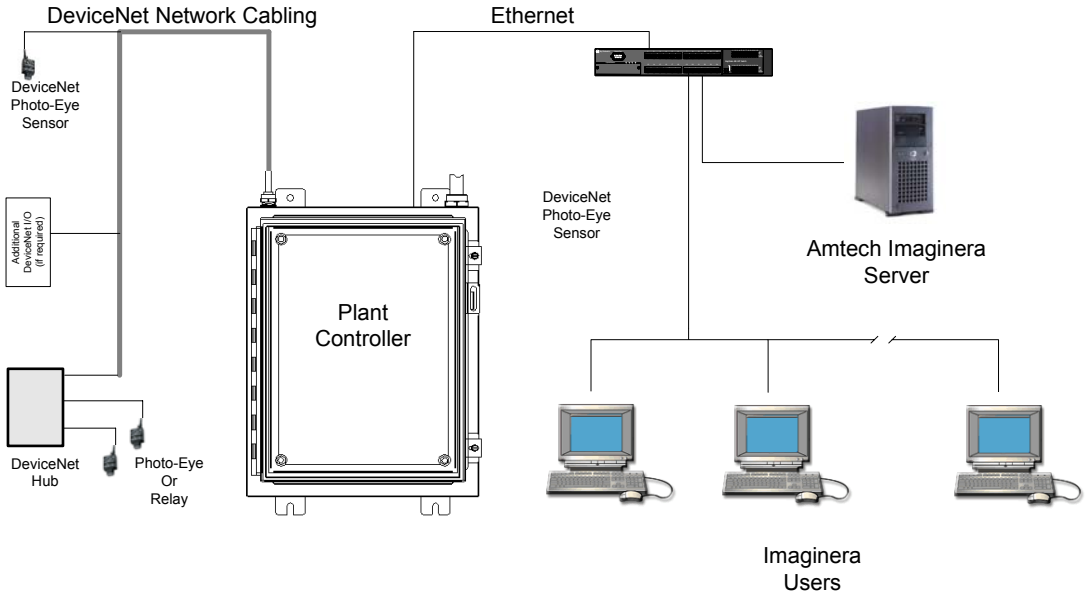


Figure 1 – Real-Time Plant Monitoring System Overview

Main Components

Plant Controller

The Plant Controller collects data from Photo-Eye sensor network (DeviceNet) and communicates to and from the Imaginera server. The Plant Controller cabinet contains the following major components:

- The main connection to the Photo-Eye sensor network (DeviceNet).
- The DeviceNet Power Supply for the Photo-Eye sensor network.
- The DeviceNet Scanner that manages communication to the Photo-Eye sensor network.
- The Programmable Logic Controller (PLC). The program inside the PLC increments and resets the piece counts from each Photo-Eye sensor, and determines the operating mode and rate of each piece of equipment.
- The Industrial Computer that collects data and provides it to the Imaginera server.

The enclosure itself is oil-tight and dust-tight (NEMA 12) when installed properly. Mounting and Electrical requirements are included in the Installation section of this document.

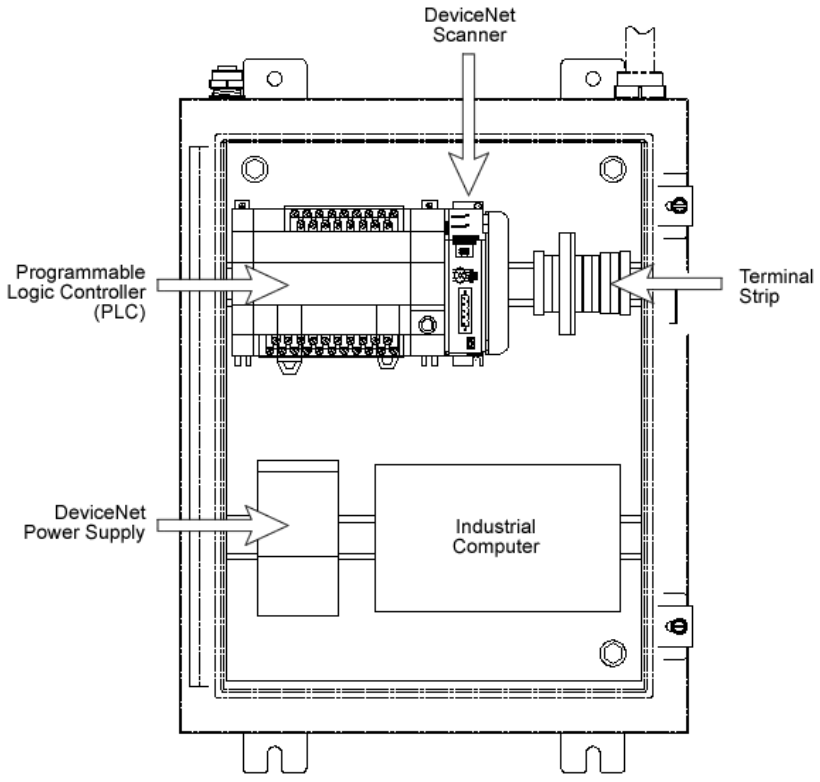


Figure 2 – Plant Controller Components

Plant Controller Specifications	
Height	20 inches (51 cm)
Width	16 inches (41 cm)
Depth	10 inches (25 cm)
Weight	65 pounds (30 kg)
Enclosure Rating (when installed properly)	NEMA 12 (Oil Tight/ Dust Tight)
Power	120 Volts AC with Ground 1 Phase, 60 hertz, 10 amps
Ethernet Network	Ethernet with RJ45 Connector
Photo-Eye sensor network	Female DeviceNet Connector

DeviceNet Network Cabling

The DeviceNet Network cabling utilizes one Trunk Line that starts at the network connector of the Plant Controller cabinet. The Trunk Line is run so that a there is a drop (connection) at each piece of equipment (1 drop for each Photo-Eye sensor). The cabling is supplied and installed by the client (see the Installation section of this document). Since the network cabling provides both power and communication, no further connections are required at each sensor.

Photo-eye Sensors

The Photo-Eye sensor is used to determine the production piece count by counting each piece of product as it passes past the Photo-Eye sensor. It is critical to install the Photo-Eye sensor properly to ensure pieces are not missed, and to prevent false counts (see the Installation section of this document).

Each Photo-Eye sensor set contains:

- Photo-Eye sensor with its network address label and bracket.
- 32 foot (10 meter) Drop Cable.
- Network Tee.
- Male Connector for the Network Trunk Cable.
- Female Connector for the Network Trunk Cable.

Mounting and cabling requirements are included in the Installation section of this document.

DeviceNet Hubs

A DeviceNet Hub Adapter is used as an alternative to a Photo-Eye to measure piece counts on a production machine. DeviceNet adapters are multi-point devices, usually 16 input points per adapter, which can receive signals from existing sensors or from new photo sensors that are not DeviceNet compatible (allows more flexibility in sensor selection).

Each DeviceNet adapter set contains:

- 16-point adapter with selectable address switch
- Fiberglass enclosure, 9” X 11”, with screw-on cover
- 16 foot (5 meter) Drop Cable.
- Network Tee.
- Male Connector for the Network Trunk Cable.
- Female Connector for the Network Trunk Cable

Mounting and wiring requirements are included in the Installation section of this document.

Installation

Plant Controller

MOUNTING

The Plant Controller should be centrally located to minimize the length of Network cabling required to reach all machines. The Plant Controller is intended to be surface mounted using the four mounting holes located on the enclosure. Please allow ample room to open the enclosure door fully and to service components inside of the enclosure.

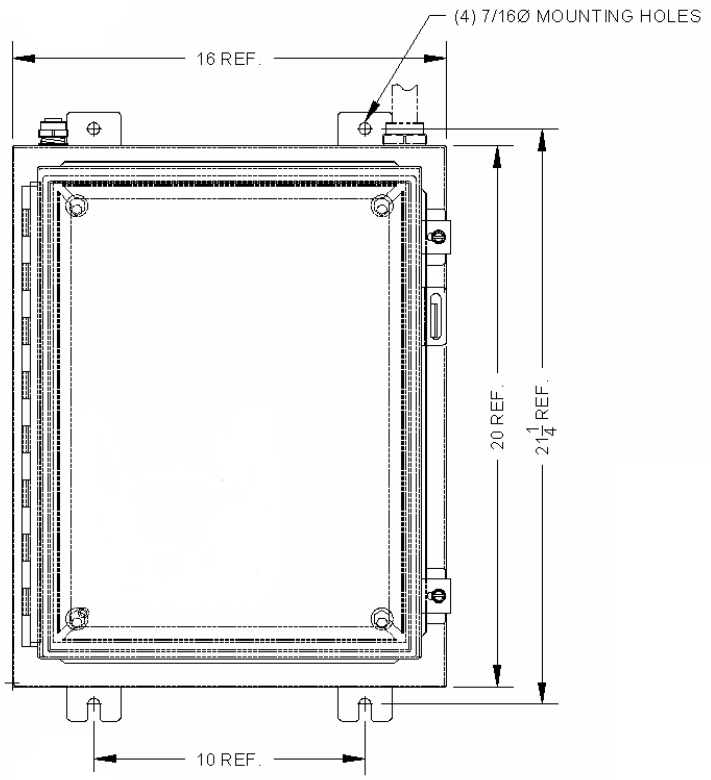


Figure 3 – Plant Controller Dimensions

Power

The Plant Controller requires 120 Volt Alternating Current (see Table) for operation and to power the Photo-Eye sensor network.

The line (black), neutral (white), and ground (green) wires should be connected to the L1, N, and GND (green) terminals respectively of the terminal block. Please refer to the following diagram (Figure 4).

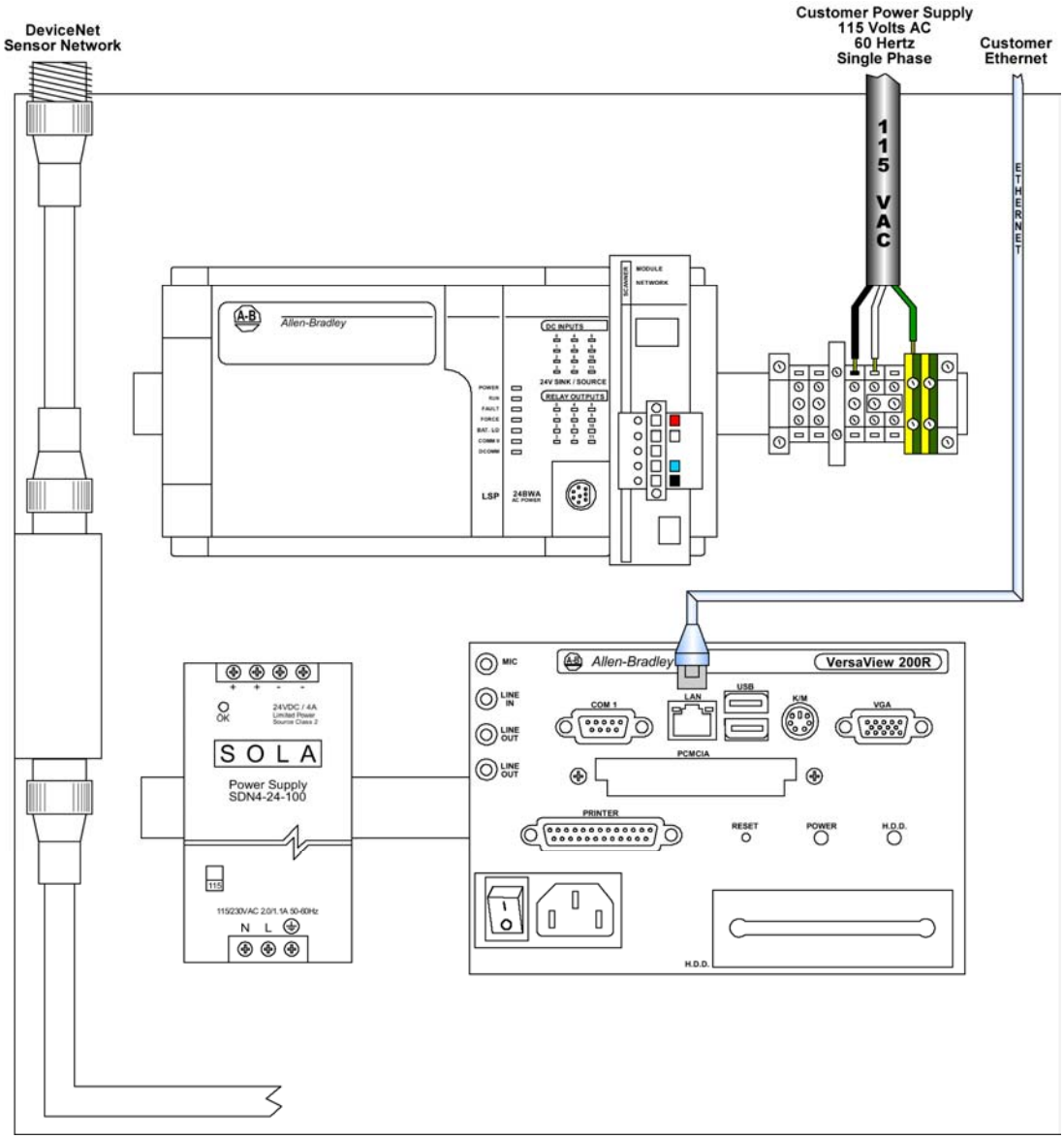


Figure 4 – Plant Controller Connections

ETHERNET NETWORK

The Plant Controller communicates to the Imaginera server via the client's plant-wide Ethernet network. One end of the Ethernet cable connects to the "LAN" connector (type RJ45) on the industrial computer. The other end of the Ethernet cable connects to the appropriate port on the client's Ethernet hub or switch.

The Ethernet hubs/switches, cabling and connectors are supplied and installed by the client.

DeviceNet Network Cabling

The Plant Controller communicates to the DeviceNet Photo-Eye sensor cabling using the bulkhead connector located on top of the enclosure. Using a male DeviceNet connector (provided), connect one end of the trunk line to the Plant Controller cabinet at that bulkhead connector. For details, see "Cable Connection Instructions" later in this document.

DEVICENET NETWORK CABLING

The Network cabling utilizes one trunk line that starts at the network connector of the Plant Controller and is run in "daisy chain" fashion so that a there is a drop at each piece of equipment (for the Photo-Eye sensor). Since the network cabling provides both power and communication, no further connections are required at each sensor.

DeviceNet "round thick" cable is used as a trunk line to communicate from the Plant Controller to each of the Photo-Eye sensors. **The cabling are supplied and installed by the client**. The Male and Female connectors for the Trunk cable, as well as the Tee connector and drop cable, are included in each Photo-Eye sensor set. The total length of cable used must not exceed 1640 feet (500 meters) in length.

DeviceNet Round Thick Cable Specification	
Allen-Bradley	1485C-P1-A300
Belden	3082A

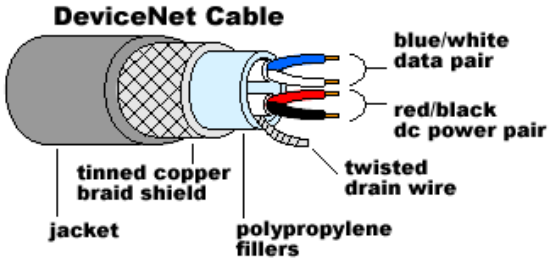


Figure 5 – Device Net Cable

CABLE ROUTING

The cable must be routed so that there will be a drop to each Photo-Eye or Adapter Hub while keeping the total length of trunk cable to a minimum. Each segment of trunk cable should be long enough so that it can be connected to the 32-foot (10 meter) drop cable and tee provided for each Photo-Eye or Adapter. Refer to the following diagram for "typical" cabling arrangement. Actual arrangement will vary depending on the layout and quantity of machines in the facility.

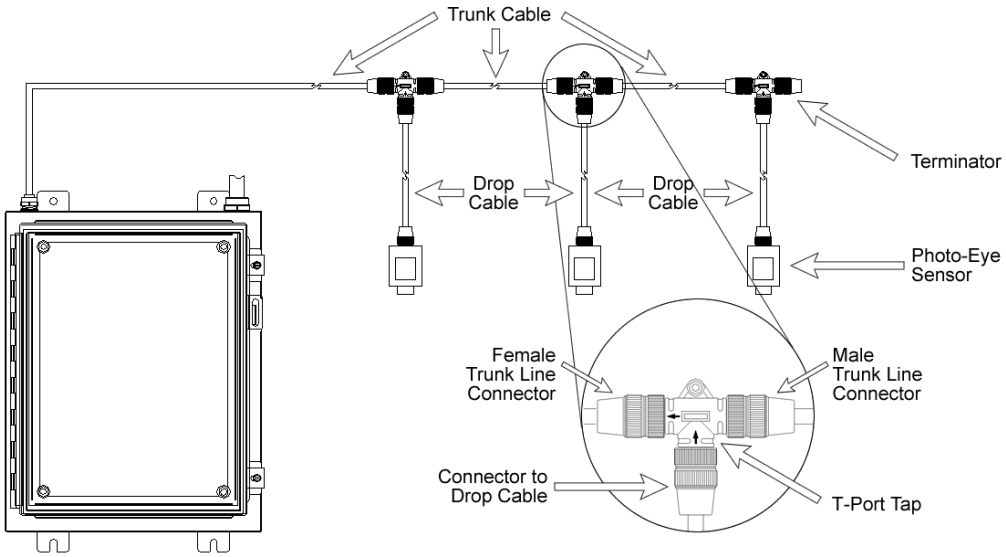


Figure 6 – Typical Photo-Eye Sensor Installation

CABLE CONNECTION INSTRUCTIONS

1. Prepare the cable jacket by cleaning loose particles from the jacket.

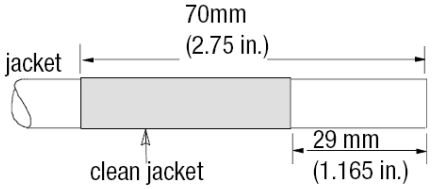


Figure 7 – Preparing the Cable Jacket

2. Strip 29 mm (1.165 in.) of the cable jacket from the end of the cable.
3. Cut the braided shield and the foil shields surrounding the power and signal conductors.
4. Trim the conductors to the same length.

5. Slide the connector hardware onto the cable in the order shown.

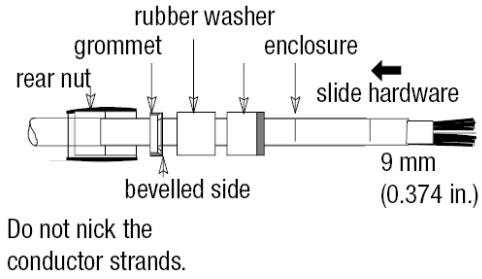


Figure 8 – Installing Connector Hardware

6. Strip 9 mm (0.374 in.) of insulation from the ends of all conductors except the bare drain wire.
   Important: Do not twist or pull the cable while tightening the gland nut.

7. Attach wires to the connector using screw terminals as seen in the following diagram.

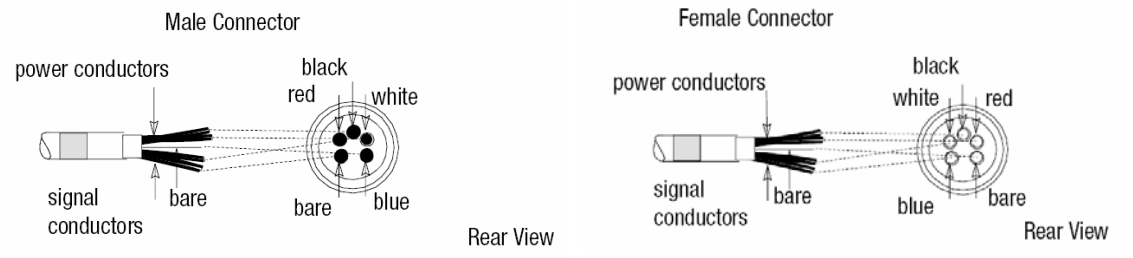


Figure 9 – Attaching Wires to the Connector

8. Screw the enclosure body to the connector.
9. Screw the rear nut into the connector enclosure.
   Important: Do not twist or pull the cable while tightening the rear nut.

TERMINATING RESISTOR

The terminating resistor (provided) must be attached to the last tee in the network (farthest along the Trunk Cable from the Plant Controller cabinet).

Photo-Eye Sensors

The Photo-Eye sensor is used to determine the production piece count. There is one Photo-Eye sensor for each machine being monitored. There is a dedicated counter in the PLC program for each Photo-Eye sensor. The counter is incremented each time a piece passes past the Photo-Eye sensor.

Each Photo-Eye sensor is provided with a label attached showing the sensor's unique network address.

MOUNTING

The Photo-Eye sensors offer a good degree of flexibility with regards to mounting location. Almost any mounting location may be used, as long as the product piece will interrupt the light beam during operation, and mechanical mounting guidelines (below) are followed.

The mounting method used for each Photo-Eye sensor must be determined on a machine-by-machine basis. Use of the supplied mounting bracket is optional. In some cases, existing machine hardware and surfaces may be used. It may be necessary to modify or custom fabricate a mounting bracket as needed to provide a suitably secure location.

The mounting location must meet the following criteria:

Mechanical: Location must provide a firm, rigid location to reduce excessive vibration. Movement of the Photo-Eye sensor during machine operation may produce false counts, and may reduce the lifespan of the Photo-Eye sensor.

Attachment: Bolts and nuts must be secured using self-locking nuts, lock washers and/or thread-lock as appropriate. This is necessary to ensure the Photo-Eye sensor does not vibrate loose during machine operation.

Cable Access: The communication cable must be routed away from those parts of the machine that move during operation. In addition, the cable must be routed away from access doors, machine guides and other similar machine components that may be moved occasionally during setup or maintenance activities.

Led Indicators:

Each Photo-Eye sensor has three LED indicators to display status information. The arrangement of the indicators is shown schematically in the following diagram, viewed looking at the face of the Photo-Eye sensor, with the light beam out the bottom, and the cable out the rear, away from the viewer.

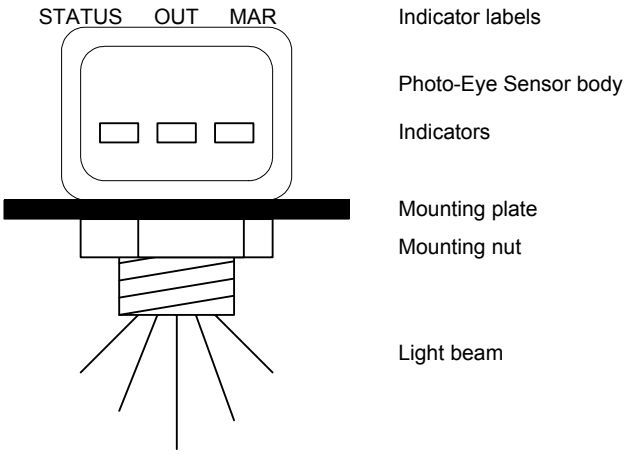


Figure 10 – Photo-Eye LED Indicators

During normal operation, the STATUS indicator should be illuminated, green in color, at all times. During normal operation, with **no product piece present** to block the light beam, the Photo-Eye sensor indicators should all be illuminated.

When a product piece is present and blocks the beam, the OUT indicator must be off; the state of the MAR indicator may be "On" or "Off" (used only for advanced diagnostics).
The following table provides details regarding the meaning of each indicator. In the table, "Margin" corresponds to the "MAR" indicator, and "Output" corresponds to the "OUT" indicator on the Photo-Eye sensor.

Photo-Eye LED Indicators			
Label	**Color**	**State**	**Status**
Output (OUT)	Yellow	On	Target Detected
Margin (MAR)	Orange	Off	Margin < 2.0
		On	Margin > 2.0
Status	Red / Green	Off	Sensor not Powered
		Green On Steady	Sensor Active and Allocated by Master
		Green Flashing	Sensor Active but not Allocated by Master
		Red Flashing	Minor Correctable Fault (Baud Rate)
		Red On Steady	Major Fault (Possible Duplicate Address)

CONFIGURATION (INITIAL SYSTEM INSTALLATION)

No action is required. All Photo-Eye sensors provided with a new Real-Time Plant Monitoring system are pre-configured, labeled, and pre-tested for the particular installation.

Re-configuration or re-addressing should be required only when a Photo-Eye sensor is replaced (see next section).

CONFIGURATION (PHOTO-EYE SENSOR REPLACEMENT)

Each Photo-Eye sensor must have a unique address in the DeviceNet system. Each Photo-Eye sensor is shipped from the factory with an address of 63.

When replacing a faulty Photo-Eye sensor, the sensor must be re-configured to set its DeviceNet network address. A detailed procedure for re-configuring a Photo-Eye sensor is outside the scope of this Installation Manual.

A detailed procedure is contained in the User Manual for the DeviceNet Scanner (available from Allen Bradley):

Allen Bradley document number: 1769-SDN
Document title: "Compact I/O 1769-SDN DeviceNet Scanner Module"

DeviceNet Hubs

The DeviceNet Hub is used instead of a Photo-Eye on some machines to determine the production piece count. There must be either a Photo-Eye or an input to a DeviceNet Hub for each machine being monitored on the RPM system. The DeviceNet input may come from an isolated signal from an existing photo sensor, a PLC input/output, a micro-switch or another source. There is a dedicated counter in the PLC program for each Photo-Eye sensor and for each individual input of the multi-point adapter. The counter is incremented each time a piece passes past the Photo-Eye sensor or a signal is received at the DeviceNet Hub.

MOUNTING

The DeviceNet Hubs are supplied mounted in a fiberglass reinforced plastic enclosure. The enclosure must be securely mounted in a suitable location. The preferred location for an adapter is centrally located to all of the production machines that connect to that adapter. The mounting location must provide a firm, rigid location to reduce excessive vibration. Mounting hardware should include self-locking nuts, lock washers and/or thread-lock as appropriate. The DeviceNet drop cable must be routed away from obstructions that could damage the cable. In addition, the cable must be routed away from access doors, machine guides and other similar machine components that may be moved occasionally during installation or maintenance activities.

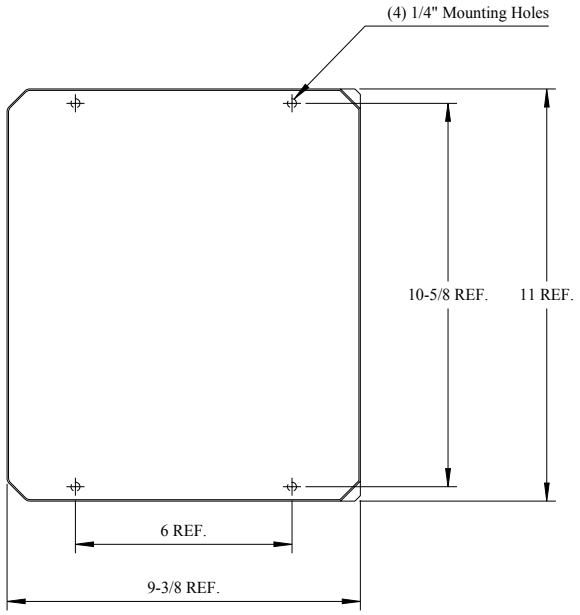


Figure 11 – DeviceNet Hub Dimensions

WIRING PHOTO-EYES OR CONTACTS

Standard hook-up wire is required to carry the input signal from each machine to the DeviceNet Hub. Typically, 18 Ga., multi-strand, 3-conductor shielded and jacketed cable should be used. The arrangement of the input wiring for a typical unit is shown schematically in the following diagram.

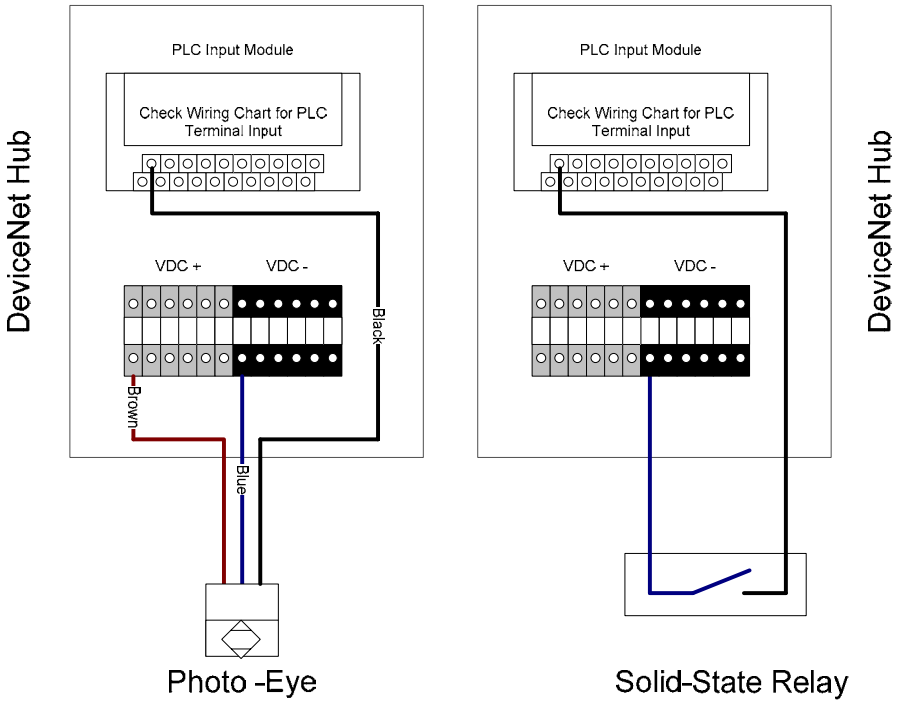


Figure 12 – DeviceNet Hub Wiring Arrangement

Each DeviceNet Hub Adapter is provided with a label attached inside the enclosure with a wiring chart, showing which production machines must be connected and the position that each machine occupies at the adapter hub input connection.

The following chart shows a typical label diagram (partial):

DeviceNet #1
1790D-T16BV0
Address: 1

Wire	Terminal	Address	Description	Equip Id
00100	**0**	**X0**	125-Stock "A" Labeler	1
00101	**1**	**X1**	166-Koppers 1c Rdc	2
00102	**2**	**X2**	164-Bobst Spo 1575	3
00103	**3**	**X3**	163-Bobst Spo 1600	4
00104	**4**	**X4**	161-BOBST SP 1600	5
00105	**5**	**X5**		
00106	**6**	**X6**		
00107	**7**	**X7**		
00108	**10**	**X10**		
00109	**11**	**X11**		
00110	**12**	**X12**		

Chart of Wiring Connections (partial)

LED INDICATORS

Each DeviceNet Hub has two (2) primary LED indicators; one to indicate module status and the second to indicate network status. There are also LED indicators for each input connection (up to 16 for the 16 point hub).

Adapter MODULE/NETWORK LED Indicators		
LED Indicator	**Status**	**Description**
Module Status	Solid RED	Unrecoverable Fault in Adapter.
	Flashing RED	Unrecoverable Fault in Adapter.
	Solid GREEN	Normal Operation
	OFF	Loss of Power
Network Status	Solid RED	Unrecoverable Communication Fault
	Flashing RED	Recoverable Communication Fault
	Solid GREEN	Communications Normal
	Flashing GREEN	Communication Path Error

During normal operation, with **no product piece present**, the input indicators will **NOT** be illuminated. When a product piece is present and causes a signal, the input indicator will illuminate.

CONFIGURATION (INITIAL SYSTEM INSTALLATION)

No action is required. All Adapter Hubs provided with a new Real-Time Plant Monitoring system are pre-configured, labeled, and pre-tested for the particular installation.

Wiring input connections from individual production machines must be done in the correct sequence for the RPM system to properly identify each unit.

CONFIGURATION (ADAPTER HUB REPLACEMENT)

Each Adapter Hub has a unique address in the DeviceNet system. The address of each Adapter Hub is set with the two (2) rotary dials on the top of the unit. Addresses for 00 to 99 are possible. A replacement hub must be set to the same addresses as the hub it replaces.

Input connections, similarly, must be re-connected in the same order to the replacement Adapter as the original. The correct order is imperative for the RPM system to properly identify all production machines connected to each hub.

USE OF EXISTING MACHINE SIGNALS

When using a DeviceNet Hub with an existing signal from a photo sensor (PLC output, etc.) it will usually be necessary to provide some method of signal isolation so that the signal strength is not diminished or adversely affected.

Typically the use of a general purpose relay will suffice for this purpose; however, a standard mechanical relay should be avoided as it may have limited response capability or exhibit contact bounce and flutter. It is therefore recommended that a solid state relay be used or at least a magnetic reed type isolation relay with high input impedance.

Typical Solid State Relays			
Input / Control Voltage	**Rated Resistive Load**	**Manufacturer**	**Part Number**
5 to 24 VDC	10A at 5 to 200 VDC	Omron	G3NA-D210B-DC5-24
		Allen-Bradley	700SH5FZ24
100 to 240 VAC		Omron	G3NA-D210B-AC100-240
		Allen-Bradley	

Typical Hook-Up Cables	
Manufacturer	**Part Number**
Belden	

Troubleshooting

General

Whenever piece counts for an individual machine are incorrect, the machine's Photo-Eye sensor should be inspected to be sure it is still installed and operating properly.

After a Photo-Eye sensor has been in service for a while, its mounting hardware may vibrate loose. The lens may be dirty or it may become permanently blocked by some unexpected obstruction. The cable may be disconnected or damaged.

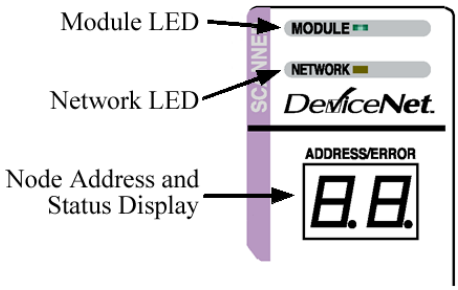
With no product piece present in the light beam, check the indicators on the Photo-Eye sensor. All three indicators should be illuminated. Refer to the preceding section for details regarding the LED Indicators

Whenever the piece counts from all machines is incorrect, check the entire length of the DeviceNet Trunk Cable for breaks or damage. Also, check the 24 VDC Power Supply and the DeviceNet Power Tap in the Plant Controller cabinet. Be sure there is power to the Tap from the Supply (24 VDC).

DeviceNet Scanner Error Codes

The DeviceNet Scanner is connected to the PLC and is located inside the Plant Controller. If DeviceNet is powered up, and the indicators on all Photo-Eye sensors are properly illuminated, it may be necessary to resolve error codes shown on the DeviceNet Scanner.

The following table summarizes the meanings of the LEDs and numeric codes.



Indicator	Color/ Status	Indicates	Recommended Action
Module	Off	No power applied to module.	Apply power.
	Flashing Green	No Bus Master (MicroLogix or CompactLogix controller) present.	Verify module connectors are properly seated. If they are, cycle power to the controller. If this does not correct the problem, replace the controller. If replacing the controller does not correct the problem, replace the 1769-SDN.
	Solid Green	Normal operation.	No action required.
	Flashing Red	Recoverable Fault - Memory has been erased or is being programmed.	Complete flash update or start a new update.
	Solid Red	Unrecoverable fault	Verify module connectors are properly seated. If they are, verify that bus terminator/end cap is installed. Cycle power. If still faulted, replace the module.
Network	Off	No module power, no network power, or communications are not occurring between the module and the DeviceNet network. (This may be an acceptable condition.)	Verify module has power. Check that the DeviceNet cable is securely connected and the DeviceNet network is powered. Verify that network power is adequate (11 to 25V dc).
	Flashing Green	Device is operational. There are no connections established with any of the network devices.	If the module is supposed to be controlling DeviceNet slaves, configure the module's scan list.

	Solid Green	Normal operation. Scan list is configured. Module is not in Idle mode.	No action required.
	Flashing Red	One or more of the devices that the scanner is communicating with is in a timed out state.	Monitor the status display, or the module's status field to determine which slave device is offline.
	Solid Red	Critical network failure. Duplicate DeviceNet node address detected.	Reset module. Change module's node address or change conflicting device 's node address. If failure continues, replace module.
7-Segment Numeric Display	Node Address and Status Display	Indicates diagnostic information about the status of the module. When the numeric display is showing 0 to 63, it is indicating the 1769-SDN module's DeviceNet node address. When it shows 70 to 99, it indicates an Error Code for the displayed node address. When it flashes alternating numbers, one is the Error Code (70 to 99), and the other is the Node Number (0 to 63) that has generated the error. See the list of Error Codes on page 17 for more information.	

Some Common Error Codes on the LED display of the DeviceNet Scanner	
Error Code	**Description**
77	There is a size mismatch and most likely, the module is configured improperly. Go back and check the module in question, also verify the scan list entry.
78 or 72	The module in question is not communicating properly. A 72 means the connection is very intermittent and a 78 means the module is not responding at all. Usually faulty wiring or power are the causes of these errors.
91	A Bus Off condition exists. This can mean several things: 1. There is a short between one or both of the CAN lines (Blue or White) to either Ground (Shield or Black) or to 24v (Red). (Verify wiring with an ohmmeter or the 1788-MCHKR media checker). 2. It could mean there are devices on the network with the incorrect baud rate. Removed devices and cycle power after each device is removed. Check the SDN's baud rate – refer the knowledge base and download the troubleshooting guide (document ID number G15098). 3. 3. It could mean that there is a large amount of noise on your network. This could be due to High Voltage power cables being too close. Improper or lack of termination. Improper grounding (again refer Knowledge base document ID G15098 or to the DeviceNet Media installation guide, publication DN-6.7.2.
92	There is no network power (24V). Verify cabling or use an isolated, regulated, power supply rated for DeviceNet usage.

A detailed procedure is contained in the User Manual for the DeviceNet Scanner (available from Allen Bradley):

Allen Bradley document number: 1769-SDN
Document title: "Compact I/O 1769-SDN DeviceNet Scanner Module"

Code (decimal)	Name	Description	Recommended Action
70	Duplicate Node	Controller has Failed Duplicate Node Address Check. The node address selected is already in use.	Change the module's or conflicting device's network address (node number) to an available one.

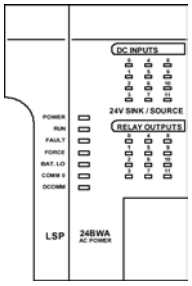
71	Illegal Scan List Data	Illegal data in Scan List.	Reconfigure the scan list table and remove any illegal data.
72	Slave Timeout	One of the module's slave devices has stopped communicating.	Inspect the module's slave devices and verify the DeviceNet connections.
73	Electronic Key Mismatch	The slave device Vendor ID key parameter does not match the slave's configuration in the module's scan list.	Make sure that the device at the flashing node address matches the desired electronic key (vendor, product code, product type)
75	No Messages Received	No network traffic received by the scanner. 10 seconds have elapsed and no network traffic for the module or for any other device have been received by the module.	Verify the scan list is correctly configured to scan slave devices. Verify DeviceNet network connections.
76	No Message For Scanner	No direct network traffic for the scanner detected. 10 seconds elapsed and no DeviceNet input being screened by the module has been received.	None. There are other active devices on the network, initiating messages, but none of the messages are for the module.
77	Slave Data Size Mismatch	The data being received from the slave device does not match the configuration in the scan list.	Either reconfigure the slave device, or change the module's scan list to match the slave device.
78	No Such Device	Slave device in scan list does not exist.	Either add the device to the DeviceNet network, or delete the device's entry in the scan list.
79	Transmit Failure	The module has failed to transmit a message.	Make sure that the module is connected to a valid network. Check for disconnected cables.
80	In Idle Mode	Module is in Idle mode.	Put the controller into Run mode and enable the scanner Run bit (bit 0 of the Module Command Array = 1). See page 15.
81	Scanner Faulted	The Scanner has stopped producing and consuming I/O data. This condition does not affect the scanner's system or messaging modes.	Check the FAULT value in the module command array.
82	Fragmentation Error	Error detected in sequence of fragmented I/O messages from device.	Check scan list table entry for slave device to make sure that input and output data lengths are correct. Check slave device configuration.
83	Slave Init Error	Slave device is returning error responses when the module attempts to communicate with it.	Check slave device's configuration. Reboot slave device.
84	Not Yet Initialized	Module has not completed its initial attempt to establish communications with its slaves.	None. This code clears itself once the module properly initializes all slave devices on the network.
85	Receive Buffer Overflow	Data size returned is larger than expected.	Configure the slave device for a smaller data size.

86	Device Went Idle	Device is producing Idle state.	Check the device configuration and lave node status.
90	Disabled Network	DeviceNet Port is Disabled	Check for the disable being set in the module command array.
91	Bus Off	Bus off condition detected on integral DeviceNet port.	Check the DeviceNet connections and physical media integrity. Check system for failed slave devices or other possible sources of network interference. Check the Baud Rate.
92	No DeviceNet Power	No network power detected on DeviceNet port.	Provide network power. Make sure the module drop cable is providing the proper power to the DeviceNet port.
95	FLASH Update	Flash Update In Progress	None. **DO NOT** disconnect the module from the network while a flash update is in progress.
98	Firmware Corrupted	Firmware is corrupted.	Reflash module firmware. **DO NOT** power cycle the module. Doing so will cause the module to become inoperable If the problem persists contact Rockwell Automation Technical Support.
99	Hard Fault		Cycle Power. Reflash module firmware. Contact Rockwell Automation Technical Support.

PLC Error Codes

In the unlikely event the PLC is suspected of improper operation, the following information may be useful. This information was obtained from the Allen Bradley PLC documentation, and is included here for convenience.

Understanding Controller LEDs



The controller status LEDs provide a mechanism to determine the current status of the controller if a programming device is not present or available.

LED	Color	Indicates
POWER	off	No input power, or power error condition
	green	Power on
RUN	off	Not executing the user program
	green	Executing the user program in run mode
	green flashing	Memory module transfer occurring
FAULT	off	No fault detected
	red flashing	Application fault detected
	red	Controller hardware faulted
FORCE	off	No forces installed
	amber	Forces installed
BATTERY LOW	off	battery OK
	amber	battery needs replacement
COMM 0	off	Not transmitting via RS-232 port
	green	Transmitting via RS-232 port
COMM 1 (1764-LRP only)	off	flashes when communications are active
	green	
DCOMM	off	Configured communications
	green	Default communications
INPUTS	off	Input is not energized
	amber	Input is energized (terminal status)
OUTPUTS	off	Output is not energized
	amber	Output is energized (logic status)

When Operating Normally

The POWER and RUN LEDs are on. If a force condition is active, the FORCE LED turns on and remains on until all forces are removed

When an Error Exists

If an error exists within the controller, the controller LEDs operate as described in the following tables.

If the LEDS indicate:	The Following Error Exists	Probable Cause	Recommended Action
All LEDs off	No input power or power supply error	No line Power	Verify proper line voltage and connections to the controller.
		Power Supply Overloaded	This problem can occur intermittently if power supply is overloaded when output loading and temperature varies.
Power and FAULT LEDs on solid	Hardware faulted	Processor Hardware Error	Cycle power. Contact your local Allen-Bradley representative if the error persists.
		Loose Wiring	Verify connections to the controller.
Power LED on and FAULT LED flashing	Application fault	Hardware/Software Major Fault Detected	For error codes and Status File information, see *MicroLogix 1200 and 1500 Programmable Controllers Instruction Set Reference Manual*, Publication 1762-RM001C-EN-P.
RUN FORCE FAULT LEDs all flashing	Operating system fault	Missing or Corrupt Operating System	See Missing/Corrupt OS LED Pattern on page D-2.